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A SYSTEMATIC APPROACH TO
GLOBAL EQUITY SECTORS ROTATION

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The following lines echo multifold voices that I cannot abstain from taking note of.

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Abstract

Back in 2000, the burst of the IT bubble sunk global equities. Regardless, five out of ten GICS sectors had positive returns over that year. Global equity sectors rotation might become even more relevant as globalisation/integration evolve, with industry effects eventually taking over country effects. This paper details the set-up and performance of a sector rotation systematic strategy, supporting Millennium BCP's Wealth Management Unit on its asset allocation procedures. It is shown that momentum and low-volatility "anomalies" are evidenced at industry level, macroeconomic indicators support a choice between cyclical/defensive sectors, and that specific factors further fine-tune an efficient rotation.

Keywords: Global Equity Sector Rotation; Asset Allocation; Factor Investing; Macroeconomic indicators.

Introduction

This paper aims to build a systematic strategy to handle the relevance of global equity sectors rotation, by combining some of the most widely studied factors with several others also found to be significant drivers of sector returns, adding to the actual research by further studying how “each industrial sector responds to macroeconomic factors, economic policies, and news in a different and unique way” (Lamponi, 2014).

The sectors within which the strategy aims to efficiently allocate capital are the following¹:

1. Materials; Companies that manufacture chemicals, building materials and paper products. This sector also includes companies engaged in commodities exploration and processing.
2. Telecoms; Companies that provide communication services using fixed-line networks or those that provide wireless access and services. This sector also includes companies that provide internet services such as access, navigation and internet related software and services.
3. Consumer Discretionary; This sector includes retail stores, auto and auto parts manufacturers, companies engaged in residential construction, lodging facilities, restaurants and entertainment companies.
4. Consumer Staples; Companies engaged in the manufacturing of food, beverages, household and personal products, packaging, or tobacco. Also includes companies that provide services such as education & training services.
5. Energy; Companies that produce or refine oil and gas, oil field services and equipment companies, and pipeline operators.

¹ Description as in the Morningstar Global Equity Classification Structure.

6. Financials; Companies that provide financial services which includes banks, savings and loans, asset management companies, credit services, investment brokerage firms, and insurance companies.
7. Healthcare; This sector includes biotechnology, pharmaceuticals, research services, home healthcare, hospitals, long-term care facilities, and medical equipment and supplies.
8. Industrials; Companies that manufacture machinery, hand-held tools and industrial products. This sector also includes aerospace and defense firms as well as companies engaged in transportations and logistic services.
9. Information Technology (IT); Companies engaged in the design, development, and support of computer operating systems and applications. This sector also includes companies that provide computer technology consulting services. Also includes companies engaged in the manufacturing of computer equipment, data storage products, networking products, semi-conductors, and components.
10. Utilities; Electric, gas, and water utilities.

Note that Morningstar Global Equity Classification Structure also classifies equities into the Real Estate sector. However, the amount of data regarding such index prices is limited, and therefore this sector was excluded to allow a backtest across a larger time-series, guaranteeing its robustness.

Remarkably, the different ways in which each sector responds to new information is quite visible in the following table of annual returns in US dollars for the MSCI Global Sector Indexes.

Figure 1 – Calendar returns in US dollars for the MSCI Global Sector Indexes.

Year / Index	MSCI World	MSCI IT	MSCI Health Care	MSCI Financials	MSCI Energy	MSCI Utilities	MSCI Telecoms	MSCI Materials	MSCI Industrials	MSCI Consumer Staples	MSCI Consumer Discretionary
1997	14.2%	22.6%	35.6%	17.2%	17.4%	10.2%	22.2%	-11.6%	0.7%	22.7%	7.7%
1998	22.8%	68.0%	35.2%	10.9%	2.3%	20.8%	50.1%	-2.0%	6.2%	20.6%	24.4%
1999	23.6%	99.6%	-11.1%	6.6%	19.9%	-14.9%	42.8%	26.0%	25.8%	-17.2%	31.6%
2000	-14.1%	-41.8%	25.5%	8.5%	4.3%	19.6%	-41.7%	-14.9%	-2.6%	9.1%	-24.2%
2001	-17.8%	-29.7%	-14.0%	-18.3%	-8.8%	-24.2%	-26.4%	-6.8%	-16.8%	-9.8%	-11.0%
2002	-21.1%	-38.8%	-18.9%	-18.0%	-8.4%	-18.6%	-30.4%	-6.3%	-23.5%	-4.8%	-23.2%
2003	30.8%	47.6%	18.0%	35.5%	22.9%	23.9%	22.8%	41.9%	35.9%	14.7%	35.7%
2004	12.8%	2.1%	4.7%	14.8%	25.3%	24.3%	14.7%	15.7%	17.5%	9.9%	13.6%
2005	7.6%	4.2%	7.6%	8.7%	26.2%	9.7%	-12.5%	17.1%	10.2%	3.9%	0.0%
2006	18.0%	8.6%	9.0%	20.9%	15.8%	31.5%	27.8%	26.2%	16.8%	18.0%	19.3%
2007	7.1%	14.4%	2.5%	-10.5%	27.5%	18.5%	17.9%	31.2%	13.6%	16.3%	-4.5%
2008	-42.1%	-44.4%	-22.9%	-55.6%	-39.4%	-31.4%	-35.6%	-51.0%	-44.2%	-24.9%	-42.8%
2009	27.0%	50.9%	16.4%	27.7%	22.9%	2.0%	8.6%	58.4%	23.9%	18.6%	37.3%
2010	9.6%	9.5%	0.4%	2.3%	9.5%	-4.5%	5.3%	19.4%	21.3%	10.1%	22.8%
2011	-7.6%	-3.4%	7.2%	-20.7%	-1.9%	-6.8%	-4.1%	-21.2%	-10.0%	6.0%	-6.3%
2012	13.2%	12.0%	15.1%	25.6%	-0.5%	-1.9%	1.7%	9.0%	13.5%	10.7%	22.3%
2013	24.1%	27.2%	33.9%	24.3%	15.3%	8.9%	26.6%	1.2%	29.7%	18.6%	37.3%
2014	2.9%	14.7%	16.3%	0.9%	-13.7%	12.0%	-5.0%	-7.1%	-1.3%	5.0%	2.4%
2015	-2.7%	3.6%	5.2%	-5.6%	-25.0%	-9.3%	-0.6%	-17.2%	-3.8%	4.2%	4.0%
2016	5.3%	10.1%	-8.3%	9.4%	22.8%	2.9%	2.4%	20.1%	10.8%	-0.4%	1.5%

The figure above highlights some interesting facts. Firstly, that the burst of the IT bubble in 2000 dragged the MSCI World down by 14.1%, but regardless of that half of the sectors had positive annual returns², some even with double-digit figures, stressing out the importance of an effective sectoral allocation. On the other hand, during the global financial crisis in 2008 correlations across risky assets surged, not leaving any room for a long-only strategy of equity sector rotation to provide positive absolute returns (despite that it still might prove quite effective to outperform its benchmark in relative terms³). Taking this into consideration, the strategy intends to rotate across equity sectors in order to enhance risk-adjusted returns and avoid huge draw-downs⁴, by combining technical factors, macroeconomic factors and specific factors. Note that, for the purpose of systematically adjusting the strategy to the distinct phases of macroeconomic cycles, the aforementioned sectors were divided into two groups:

² Health-Care, Financials, Energy, Utilities and Consumer Staples.

³ In 2008, Defensive sectors significantly outperformed Cyclical sectors (returns were less negative).

⁴ Namely the ones of provided by a buy-and-hold allocation to the MSCI World.

1. Cyclical sectors; Sectors driven by the real economy, and thus procyclical with economic growth - when the economy is in an expansion these sectors tend to outperform, and when the economy is in a downturn these sectors tend to underperform. In other words, these sectors most likely have a beta greater than 1. Thus, the following sectors were identified as cyclicals: IT, Consumer Discretionary, Industrials, Materials, Energy and Financials.
2. Defensive sectors; Sectors whose core business model focus on providing goods/services that the average consumer considers as essential to its lifestyle, and thus requires them regardless of the stage of the economic cycle. These sectors tend to underperform in economic expansions and to outperform in recessions, usually leading to a beta lower than 1. The following sectors were identified as defensives: Health Care, Utilities, Telecoms and Consumer Staples.

Literature Review

Far-reaching research have addressed the importance of an efficient global equity sector rotation. Richard A. Weiss (1998) argues that as capital markets become highly integrated, and should globalisation trends continue, industry effect will be as important as (if not more important) than country effect as a source of risk diversification. Moreover, “as political boundaries become less important, the factors of production that drive various industries will become the single most important determinant of global asset returns”. Furthermore, as the author also argues, an overweight in a certain country might implicitly, and maybe unintentionally, become an overweight in a certain sector (for instance, an overweight in Australia will most likely be exposed to the same risks as an overweight in natural resources).

Chong & Phillips (2015) evaluated the incorporation of several macroeconomic factors in sector rotation strategies. This followed research on how sector rotation strategies

based on changes in the Federal Reserve monetary policy were especially effective during restrictive monetary periods, by taking a defensive posture - in such periods, the strategy registered returns twice that of the benchmark but with much less risk (Conover, Jensen, Johnson, & Mercer, 2008).

The research on industry momentum investment strategies is also extensive. O'Neal (2000) tested the performance of a momentum strategy on sector funds, observing that "portfolios of previous top-performing industry funds far out-stripped portfolios of previous poor performers", and further research argues that such strategies "appear highly profitable" even after controlling for several risk exposures or microstructure influences (Moskowitz, Grinblatt, Journal, & Meeting, 2016).

Methodology

The benchmark of the strategy is an equally weighted portfolio of the MSCI Global Industry Indexes (i.e, an equally weighted portfolio of the aforementioned described ten GICS sectors). Global equities were chosen to fully isolate industry effects from country effects. Weiss (1998) argues that "the only fair test of sector rotation would be performed on a global basis, as only through global diversification can one mitigate country risk and thereby achieve a pure industry allocation". Note also the reasoning behind the choice of an equally weighted benchmark instead of a market-weighted benchmark: this choice was not only due to the benefits of its simpler computations, but also because it makes it easier to interpret the convictions in each sector as well as the interactions among the analysed factors. Moreover, research shows that an EW portfolio tends to outperform the value- and price-weighted portfolios in terms of risk-adjusted performance (Plyakha, Uppal, & Vilkov, 2012).

Then, each month, by combining the systematic rules described below, each sector might receive a final overweight or underweight (i.e, an active weight relative to the weight in the benchmark). Note that each overweight to a sector must be financed with an underweight to another, ensuring that weights still sum to 100%. In other words, the main purpose of the strategy is not to forecast absolute returns, but to allocate capital in such a way that it gives a greater weight to sectors that are expected to perform better than others in relative terms. If that is achieved in a consistent and robust manner, then the strategy will outperform its benchmark.

The backtest is made in a data period ranging from January of 1996 to September of 2017. A long-only and a long-short strategy⁵ were backtested. The systematic approach follows the same ideological rules for the two strategies, and therefore both strategies aim to test the resilience of the same factors/theoretical background. The only difference is that in the long-short strategy the amplitude of the overweights/underweights is greater, such that weights become more extreme and, eventually, underweights become short-positions. The active weights described further on refer to the long-only strategy unless stated otherwise⁶. Regardless of the wider tracking error, the long-short strategy was found to be useful as, being a “high-conviction strategy” (reflected in its more extreme active weights), it could more properly gauge the effect of each factor in performance, since the effect of each factor is amplified and therefore easily distinguished in a ceteris-paribus framework.

The systematic rules used can be briefly summarized in three main sets:

I - Technical factors: each month, the ten sectors are ranked by their momentum (an average of previous 1 month, 3 months, 6 months and 12 months returns) and

⁵ The long-short strategy is a net-long strategy, as weights in each sector still sum to 100%.

⁶ To obtain the active weights for the long-short strategy, multiply the weights referred by a factor of 4.

historical volatility (standard deviation of returns in the past 12 months). Then, a final rank is computed by averaging the ranking of a sector's momentum with the ranking of a sector's low volatility⁷, for the purpose to have an ordered list with the sectors that experienced the greatest momentum with the lowest possible volatility.

II - Macroeconomic factors: Credit Risk is measured by the *US High Yield OAS index*, and if it is above (below) its 6 months moving average an underweight (overweight) is given to cyclical sectors (vice-versa for defensive sectors); ISM New Orders, a leading economic indicator, favours cyclicals (defensives) if above (below) its 6 months moving average; and the slope of the Yield Curve for United States Treasury Bonds, defined as the difference between the 10Y UST yield and the 2Y UST yield, also used to try to forecast future economic activity, favouring cyclical sectors if it is positive and its slope increased relative to the past month, while favouring defensive sectors if it is negative or its slope decreased relative to the previous month.

III - Specific factors: The previous technical and macroeconomic convictions are fine-tuned to some specific factors, regarding the importance of such key specific drivers. Namely, convictions about the future performance of Energy and Materials sectors are systematically adjusted for the performance of the underlying commodities⁸; the position in Financials vs Defensive sectors is systematically adjusted to the movement in market yields, given that interest rates are a key driver of banks' future profits, while acting as a drag to Defensives that are, among equity sectors, the better bond proxies⁹; and finally, the conviction in Industrials is systematically adjusted given the monthly reading of the

⁷ A marginally higher ponderation was given to the momentum factor, in order to avoid an eventual tie between sectors.

⁸ The chosen underlying commodity for Energy equities was WTI Oil, while for Materials equities it was considered an index of Industrial Metals.

⁹ Defensives tend to underperform when yields increase, and vice-versa.

ISM Manufacturing, a leading indicator computed given managers' expectations about the manufacturing sector.

Following, the rationale behind each set of factors is described more intensively, as well as the systematic rules used to act upon them.

Methodology I - Technical factors

The main idea is to combine two of the most intensively researched financial markets' anomalies: that a portfolio of low-volatility assets tends to outperform one composed of high-volatility assets (Ang, Hodrick, Xing, & Zhang, 2009), and that "industry momentum investment strategies, which buy stocks from past winning industries and sell stocks from past losing industries, appear highly profitable" even after controlling for several risk exposures or microstructure influences (Moskowitz, Grinblatt, Journal, & Meeting, 2016). This combination is not unpremeditated, as it aims to control the crash risk from investing in momentum: as Barroso & Santa Clara (2015) found, the risk of momentum is highly variable but also highly predictable, and that "managing this risk virtually eliminates crashes". While the previous authors use an estimate of momentum risk to scale the exposure to the momentum strategy – in order to have a constant risk over time –, here the proceeding aims to follow from the intuition behind that result: for instance, if certain sector has the greatest momentum but also the highest volatility, its ranking would be somewhat neutralized in order to avoid the overweight that a plain-vanilla momentum strategy would attribute to that sector. A final ranking is thus computed, and partial active weights¹⁰ are attributed accordingly. In the long-only

¹⁰ Partial active weights in the sense that this is a contribution to the final active weight. Namely, the final active weight in a sector equals the sum of the partial active weights obtained by the methodology applied to each set of factors (technical + macroeconomic + specific). For instance, a sector might have the greatest momentum and the lowest volatility, but if macroeconomic/specific factors are disadvantageous to that conviction, the final qualitative conviction in that sector would depend on whether the former offset the latter.

strategy, the sector that ranks first receives an overweight of 5%, the one that ranks second an overweight of 4%, then 2.5%, followed by 1.0% and finally 0.5%; for the worst five ranked sectors, the underweights are symmetric (i.e the sector that ranks in tenth receives an underweight of 5%, and so on¹¹).

Despite recognizing that momentum might be described as a market anomaly, there is behavioural theory that can explain its existence and, more importantly, the high likelihood of its persistence. In the Daniel et al. (1998) model, investors exhibit overconfidence and self-attribution biases, which might exaggerate and extend industry mispricing. Moreover, under the Barberis et al.(1998) model, investors also exhibit representativeness bias, causing them to become too optimistic (pessimistic) about firms with a sequence of good (bad) news, and then extrapolating those news from a single firm to the industry level, contributing to industry momentum – this model was motivated by the idea of Griffin and Tversky (1992) that people pay too much attention to the strength of the news they are presented with but too little attention to its statistical weight. And, while it is true that often there is indeed an overreaction that might lead to a future sharp reversals in asset valuations, it is also true that one would be forfeiting significant returns in the meantime: Thaler & De Bondt (1985) argue that “most people tend to “overreact” to unexpected and dramatic news events”, but also recognize that such “overreactions” can last several months without a correction in prices. The best as one can get might well be given by the described combination of momentum and low volatility, which significantly decreases the crash risk inherent to a plain-vanilla momentum investing strategy. In fact, if one would use the recommended global equity sectors rotation strategy (the further steps are described below) but with a simple momentum strategy instead of

¹¹ Conclusions and final results would be very similar if the values chosen for active weights applied to any factor were different (i.e, within a reasonable bound, and if they do not change the rationale behind the factor used, obviously).

its combination with the low volatility factor (keeping the use of other factors constant), the maximum drawdown (i.e, the crash risk) would be higher¹².

Methodology II - Macroeconomic factors

While the previous described combination of the momentum and low volatility factors partly contributes to the conviction in each sector, those convictions are fine-tuned suitably to the macroeconomic environment verified in that month. Thus, this step systematically adds to the previous preliminary active weights an additional overweight/underweight to cyclical or defensive sectors, depending on the signs flashed by the macroeconomic indicators described below. Note that, due to the lack of some economic indicators for the global economy (which would be the most appropriate ones, as the strategy invests in global equities), the United States' economy was chosen as a proxy for the global economy, and therefore the chosen indicators regard that specific economy.

Mishkin & Estrella (2000) advocate the use of the yield curve as an excellent indicator of a possible future recession, as it “significantly outperforms other financial and macroeconomic indicators in predicting recessions two to six quarters ahead”. Its efficacy as forecast tool is robust, and despite being a simple indicator, it includes information that influences economic activity, such as the current monetary policy, expectations of future inflation and real interest rates, for instance. In this paper, the yield curve is defined as:

$$\text{Yield curve} = 10 \text{ year US Treasury yield} - 2 \text{ year US Treasury yield}$$

Economic growth tends to be reflected by a positive yield curve. The drivers that shape the yield curve depend on the stage of the economic cycle, but generally reflects easing

¹² For the long-only strategy, the maximum drawdown would be 51% instead of 49%; for the long-short strategy, the maximum drawdown would be 46% instead of 41%.

financial conditions (central banks might have just lowered short-term interest rates, with the intent to accelerate economic growth after a recession) and/or robust growth expectations ahead (higher real interest rates or higher inflation expectations in the long-run, for instance). A steepening of the yield curve is interpreted as positive for economic growth too (and thus for risky assets, favouring cyclical sectors over defensive ones), as it simply shows that the yield curve has just become more positive than before.

On the other hand, an inversion of the yield curve (which is, necessarily, preceded by a flattening) might signal an economic slowdown or a recession ahead. It can also have plentiful drivers, but generally it might reflect a tightening in financial conditions (for instance, as central banks hike policy rates to cool down inflation) and/or that future economic growth expectations have declined (reflected in lower real interest rates or lower inflation expectations in the long-run).

Therefore, in this strategy, if the yield curve is positive and steeper than in the previous month, it is attributed an overweight (+1%) to cyclicals and an underweight (-1%) to defensive sectors. Conversely, if the yield curve is negative or flatter than in the previous month, it is attributed an overweight (+1%) to defensives and an underweight (-1%) to cyclical sectors.

Despite the usefulness of the yield curve as a predictor of recessions, in this strategy this indicator is complemented with two other macroeconomic/financial indicators for the sake of strengthening the confidence in the assessment of the macroeconomic environment.

Thus, the strategy also looks out at credit risk¹³ – measured by the *US High-Yield Option Adjusted Spread*. If credit risk is below its 6 month moving average, the strategy adds an overweight (+1%) to cyclicals and an underweight (-1%) to defensives; conversely, if credit risk is above its 6 month moving average, the strategy adds an overweight (+1%) to defensives and an underweight (-1%) to cyclicals.

Finally, the strategy also works with a signal coming from the New Orders sub-index of the ISM Manufacturing, a leading indicator to gauge real economic growth: if it is above its 6 month moving average, the strategy adds an overweight (+1%) to cyclicals and an underweight (-1%) to defensives; if it is below its 6 month moving average, the strategy adds an overweight (+1%) to defensives and an underweight (-1%) to cyclicals.

Methodology III - Specific factors

Finally, there were also identified several specific factors as meaningful drivers of returns in certain sectors. Firstly, the returns of commodity-related sectors (i.e., Energy and Materials), as one would intuitively expect, are strongly positively correlated to the performance of the underlying commodities, a key driver for the earnings of those sectors. While the demand for commodity prices is expected to be cyclical with macroeconomic activity (the reason why these two sectors were previously defined as Cyclicals), supply shocks are harder to forecast (for instance, current themes include the resilience/cost structure of US Shale Oil Producers, or the extent to which Chinese authorities will implement measures to curb environmental pollution). That said, the intent here is not to forecast eventual structural changes but to adapt to them. Thus, the strategy adjusts the conviction of where one is headed in the economic cycle (cyclical sectors vs defensive sectors) to the recent performance of the underlying commodities, which is a key

¹³ Following some intuition from Chan-Lau (2006), where the author uses the prices of publicly traded securities to assess systemic risk and stress testing financial systems.

fundamental driver to Energy and Materials equities. To capture these dynamics, the strategy uses a signal that gives an overweight of +2.5% (underweight of -2.5%) to Energy when WTI oil prices are above (below) its 6 months moving average. Similarly, the strategy uses a signal that gives an overweight of +2.5% (underweight of -2.5%) to Materials when Industrial Metals¹⁴ prices are above (below) its 6 months moving average. These overweights (underweights) are financed by small underweights (overweights) to all other equity sectors.

Furthermore, the strategy also uses the ISM Manufacturing Report On Business for the United States (again as a proxy for the global economy) to gauge a specific conviction on the Industrials sector. This indicator is based on monthly questionnaires answered by members of the ISM Business Survey Committee. As stated by the ISM, a reading “over 50 represents growth or expansion within the manufacturing sector of the economy compared with the prior month; a reading under 50 represents contraction, and a reading at 50 indicates an equal balance between manufacturers reporting advances and declines in their business”. Thus, the strategy attributes an overweight (+2.5%) to Industrials if the ISM is above 50 and increased compared to the previous month’s reading (i.e, if manufacturer’s expect an expansion at a faster pace than in the month before), while it attributes an underweight (-2.5%) to Industrials in case the ISM is below 50 and decreasing (i.e, if manufacturer’s expect a contraction at a faster pace than in the month before). Again, these overweights (underweights) are financed by small underweights (overweights) to all other equity sectors.

Finally, the strategy also uses a systematic rule to eventually adjust its conviction to Financials against defensives. Alessandri & Nelson (2012) found evidence of an effect

¹⁴ Measured by the Bloomberg Industrial Metals Subindex.

of interest rates on bank profitability, as “in the long run, high yields and a steep yield curve boost banks’ income margins”. They also found evidence that banks seem to “borrow short and lend long”, and despite partly hedging this maturity mismatch, that “the slope of the yield curve matters positively for interest income”. Moreover, defensive sectors, with their counter-cyclical stance and frequently having higher dividend yields, act somewhat like bond proxies. Accordingly, the strategy gives an overweight (+2.5%) to Financials and an underweight (-2.5%) to Defensive sectors when there is a bear steepening in the yield curve¹⁵, and conversely an underweight (-2.5%) to Financials and an overweight (+2.5%) to Defensive sectors when there is a bull flattening in the yield curve¹⁶.

Data and empirical results

The data used was entirely collected from Bloomberg terminals. The results prove the robustness of the theoretical rationale behind the several factors described as relevant drivers of the different global equity sectors, as well as the benefits of their use in a strategy of global equity sector rotation. Therefore, through its application, it is possible to increase risk-adjusted returns compared to an equally-weighted or market-weighted portfolio of the same global equity sectors. Cumulative returns can be found in Appendixes 5 and 6.

Note that the following sharpe ratios were computed by simply dividing the annual return by the annualized volatility, thus ignoring the use of a risk-free rate – which does not change the interpretation of risk-adjusted returns, since it should be seen as a comparison

¹⁵ Both 2Y UST yields and 10Y UST yield above its 12 months moving average, and the Yield Curve is steeper than in the previous month.

¹⁶ Both 2Y UST yields and 10Y UST yields below its 12 months moving average, and the Yield Curve is flatter than in the previous month.

of performances solely between this strategy and its benchmark. Returns are presented in euro terms, unless stated otherwise.

The benchmark (i.e the equally weighted portfolio of the ten global GICS sectors) yields an average annual return of 5.4% with an annual volatility of 13.9%, and therefore a sharpe ratio of 0.39. On the other hand, the long-only strategy yields an average annual return of 6.2% with an annual volatility of 13.0%, increasing thus the sharpe ratio to 0.47. The maximum drawdown is also reduced relative to the benchmark, from 53% to 49%¹⁷. Finally, the annual average excess return relative to its benchmark is 0.6%¹⁸. Therefore, the long-only strategy leads to better risk-adjusted returns and also to a lower draw-down than its benchmark.

Regarding the long-short strategy, the results are even more rewarding; it yields an average annual return of 8.3% with an annual volatility of 12.17% (sharpe ratio of 0.68). Furthermore, the maximum drawdown is reduced to 41%. The long-short strategy outperforms the benchmark with an annual average excess return of 2.3%.

Thus far, the performance of this equity sector rotation strategy seems robustly better than the performance of its benchmark. Regardless, excess returns could have eventually be explained by some increase in risk-exposures to a certain risk-factor. To avoid this unintentional risk-misalignment, the strategy's exposures were tested accordingly to the Global Market model and also the Carhart 4-factor model (Carhart, 1997). In order to do so, monthly returns for the risk-free asset, market risk premium, small minus big (SMB) portfolios, high minus low (HML) portfolios and the momentum factor (WML) were collected from the Kenneth R. French's data library¹⁹. The risk-free rate was subtracted

¹⁷ Drawdown curves can be found in Appendixes 7 and 8.

¹⁸ An average of the differences in annual returns between the strategy and the benchmark.

¹⁹ For the rationale behind these factors, I recommend the reading of Fama & French (1996).

from the strategy's monthly returns, and these monthly excess returns were regressed according to the stated models.

The results further support the robustness of the strategy²⁰. Regarding the long-only strategy: its regression for the Global Market model has an R Square of 54%, a beta of 0.65 (t Stat=17.3) and generates a monthly alpha (monthly abnormal return) of 0.06%; tested for the Carhart 4-factor model, it has an R Square of 89%, and loadings of 0.74 to the market risk premium (t Stat=40.44), -0.51 to the SMB factor (t Stat=-16.36), -0.18 to the HML factor (t Stat=-7.37), and -0.06 to the WML factor (t Stat=-3.69). It generates a monthly alpha of 0.1%. Given that its deviations from the benchmark are somewhat restricted (compared to the “unrestricted” long-short strategy) and that it is a long-only strategy, it was expected that it would have some exposition to the market risk premium factor. Notably, it has negative expositions to the other three factors, even for the momentum factor, which is quite interesting since this strategy uses momentum as one of the signals to its allocations. So, good news are that its alpha is not generated by any exposition to these risk factors. Regarding the long-short strategy: its regression for the Global Market model has an R Square of 20%, a beta of 0.36 (t Stat=8.1) and generates a monthly alpha of 0.5%; tested for the Carhart 4-factor model, it has an R Square of 49%, and loadings of 0.47 to the market risk premium (t Stat=12.71), -0.64 to the SMB factor (t Stat=-10.31), -0.02 to the HML factor (t Stat=-0.44, i.e not statistically significant at 10% confidence level) and 0.13 to the WML (t Stat=3.70). It generates a monthly alpha of 0.4%. Not surprisingly, it has a lower exposition to the market risk premium since it is a long-short strategy (although positive as it is a net-long strategy). Even though the higher monthly alpha is encouraging, these results should be taken with a grain of salt. Conversely to the long-only strategy, one should be aware that its loading to the WML

²⁰ Results can be found in Appendixes 1,2, 3 and 4.

factor is now positive. Furthermore, the R Square for the long-short strategy is significantly lower than the one for the long-only strategy. As such, it might be the case that the abnormal returns for the long-short strategy are justified by an increase in some risk-exposure to a certain risk factor that is not considered in the Carhart 4-factor model, in particular for the short-positions of the strategy (for instance, the liquidity risk).

Discussion

After acknowledging the improvement in risk-adjusted returns, reduction in the maximum drawdown and the achievement of an overall outperformance relative to its benchmark, it is worthwhile to discuss some interesting patterns of the aforementioned performance of the equity rotation strategy. The figures about to be described refer to the long-only strategy; for the long-short strategy, the qualitative patterns are mostly the same, being just different in their amplitude.

Firstly, the years in which the strategy has its greatest outperformance in relative terms to its benchmark are years of distress for equities²¹. Namely, in 2000, following the burst of the IT bubble, the benchmark has an annual return of -2.4% while the strategy yields an annual return of 2.4%. The symmetry is just a mere coincidence, but implies the greatest relative performance of the strategy during the backtest period (i.e, an outperformance of 4.8%). Just to framework, in that year: the MSCI World fell 14.1%; the MSCI Global IT tumbled 41.8%; and of the ten global GICS sectors, half recorded negative calendar returns. The second best relative performance of the backtested strategy occurred in 2008, the year of the global financial crisis: while the benchmark fell 36.8%, the long-only strategy returned a still sharp negative return of -33.1%, recording an outperformance of 3.7%. For an equity-only, long-only strategy (or net-long, in the case

²¹ Relative performance can be found in Appendixes 9 and 10. Relative performance for 2017 is limited to the extent of the backtest, given that data was only collected up to September 2017.

of the long-short strategy), it would always be an harsh year: the MSCI World fell 42.1%, with all of the ten GICS Global Sectors having double-digit negative returns, despite a clear relative outperformance from Defensive sectors (the “best” performing index was the MSCI Global Health Care, with a calendar return of -22.9%).

Conversely, the worst relative performance of the strategy occurred in 2009, partly missing the recovery in the year after the global financial crisis. While the benchmark returned +23.6% in that year, the equity rotation strategy underperformed by 3.8%, still recording a solid annual return of +19.8%. In 2009, the MSCI World gained 27.0%, and all of the ten sectors recorded a positive annual return, despite significant disparities across sectors due to a strong outperformance of Cyclical sectors.

Thus, the equity rotation strategy seems to be favourable to the average risk-averse investor who dislikes drawdowns. In fact, and namely through the combination of momentum with low volatility and the incorporation of macroeconomic leading indicators, the strategy systematically positioned itself in favour of more defensive sectors ahead of broad negative equity returns leading to the significant mentioned outperformances in both 2000 and 2008. On the other hand, as exact market timing is nearly impossible, the strategy misses some of the positive returns in the recoveries that eventually follow market turmoils, usually led by Cyclical sectors. In other words, the strategy seems capable of favouring Defensive sectors ahead of financial crises, but tends to stay too long with that conviction which makes it miss the initial rally in Cyclical. Over the long-term, however, the strategy indeed seems capable of increasing risk-adjusted returns, while simultaneously reducing portfolio drawdowns.

Regarding the exposures of the strategy to additional risk-factors suggested in the Carhart 4-factor model, the results also look encouraging. Firstly, the alpha is positive after controlling for those four factors. More significantly, further than the fact that strategy

abnormal returns are not a result from the exposure to those risk factors, they also seem to be either negatively correlated (eventually providing a protection against them) or uncorrelated (without significant exposure) to such factors – with the obvious exception of the significant positive exposure to the market risk premium, since this is an equity-only strategy and that the long-short strategy is a net-long strategy. On the other hand, the enthusiastic results for the long-short strategy should be taken carefully, potentially indicating a subject for future research: its R Square is significantly lower than the R Square for the long-only strategy's returns regression. As such, the short-positions of the strategy might be exposed to some risk factors (for instance, liquidity risk) that are not being considered.

One should note that the aforementioned results were reached by avoiding sources of overfitting. Factors were chosen either by economic intuition or by using previous related research. That said, all factors included added value to the strategy, *ceteris paribus* (departing from the benchmark, performance increases when backtesting each factor independently). Remarkably, the interaction of factors also seems to work in favour of an efficient equity sector rotation, leading to the aforementioned overall relative outperformance.

It is also worth noting that there were tested some factors that were expected to increase the outperformance of the strategy. Namely some fundamental ones, such as earnings growth, sales growth or capacity utilization, or other leading macroeconomic indicators, such as initial jobless claims. Nevertheless the conviction that such factors could indeed play a role in an equity sector rotation strategy, the ones just mentioned are often subject to post-release revisions. Therefore, one would commit a forward-looking bias by using a time-series of those factors, while the gathering of unrevised factors would be less straightforward. Furthermore, by having the conviction that the momentum/low volatility

combination already includes significant information about the fundamentals of each sector (in other words, positive public information weighted against negative public information should be immediately reflected in the price) and that the macroeconomic scenarios constructed were already quite robust, such factors were not included in the final strategy.

Conclusion

This paper details the rationale behind the factors that are believed to be relevant drivers to equity sectors. Then, it details the methodology behind a strategy to act upon those factors. The performance of such strategy shows that a systematic rotation across global equity sectors improves risk-adjusted returns. It is shown that: a combination of momentum with low volatility reduces the tail-risk of momentum investing, adding to previous research that industry momentum is a significant driver of returns; a distinction between defensive and cyclical sectors, followed by the consequent systematic fine-tuning of sector allocation according to the identified macroeconomic scenario, improves the strategy's performance; and that some sectors have key specific drivers, and its systematic use contributes to ensure that, for instance, the recorded momentum is justified, or that the generalization into cyclical/defensive sector is not distorted (as an illustration, a regular economic expansion would most likely benefit Financials, but the relationship would not be so linear if that expansion is being driven by Central Banks consistently lowering policy rates).

Impact in the business world and discussion of future research

If globalisation and financial markets integration do continue to increase over time, one could argue that the country effect (in the sense of the risk-premium obtained by allocating capital to equities of a certain country) would have a lower relevance for

explaining returns; conversely, as political boundaries become less important and factors of production move more freely, the risk factors that drive various industries might gain more relevance.

This paper does not argue against country allocation: currently, country effects are a very significant driver of returns – and will likely continue to be. What this paper aims to point out for further discussion is that, having identified potential key industry drivers and being shown that one can systematically act upon them to efficiently rotate across global sectors, a “pure” industry allocation might actually improve a “pure” country allocation. Sometimes investors might want to make a bet on a certain country based on their expectations of country effects, but unintentionally be making a bet on (and being exposed to) a significant industry risk: an overweight in Australia is implicitly an overweight to natural resources, and an overweight in the United States might well be an implicit overweight to Information Technology, given the predominance of these industries in such countries. Future research could focus on whether a systematic sector rotation only works when applied to global equities or if, on the other hand, it does add value when combined with a systematic country allocation. Intuitively, a simple overlap of both approaches might not make that much sense (take a potential scenario in which the overall Italian economy would be expected to accelerate at the same time that global Financials would be expected to outperform, but Italian banks, due to their idiosyncrasies, could actually underperform in such scenario), but a not so linear combination could actually work (for instance, only overweight US equities if one expects both the US economy and the IT sector to outperform).

Admittedly, this paper does not take into consideration transaction costs. That was not a major cause of concern since the main purpose of this study was to robustly identify global equity sector drivers, instead of building a strict “investment fund”. Furthermore,

allocations are made on a monthly basis, and some *a posteriori* analysis show that the strategy's active weights in each sector often do not change abruptly (i.e, from month to month convictions are often qualitatively similar even if active weights change at the margin). Thus, even if transaction costs were a concern in applying the exact active weights computed by the systematic strategy, one could just change the active weights on its portfolio when the ones suggested by the strategy change abruptly on a monthly basis (or when the qualitative conviction on a sector changes, for example). Nevertheless, future research on transaction costs could be interesting, namely if an individual investor (instead of an institutional investor) wants to apply such strategy.

On equity sectors, future research could deepen the use of these factors in industries (there are 68 industries defined by the GICS) instead of sectors (the 10 used in this paper, excluding real estate). Thus, one would test whether a greater specification would add value by more concretely identifying specific drivers to more similar firms or if, on the other hand, such specification would mean a loss of generality making it harder to identify robust drivers (in the limit it would be a stock picking strategy). Furthermore, a factor could be included to accommodate structural changes in the economy: for instance, the health care sector has been historically defensive, but as the biotech industry market weight emerges (relatively recent market tendency) one could argue that it could turn into a more neutral or even cyclical sector; thus, one could test the use of a factor similar to a rolling beta to control the eventual structural change of a certain sector/industry.

Finally, future research would also be enlightening regarding whether fund selection could improve the systematic sectoral allocation, using funds different than the MSCI benchmarks. This was not tested in this paper in order to properly address whether the strategy's performance was obtained via the pure sectoral allocation (otherwise it would not be a significant test of an equity sectors rotation strategy), but being shown that these

sectoral convictions will likely lead to overall outperformance, one can now test whether it can be further improved with a contribution from a rigorous selection of funds that invest in each equity industry.

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APPENDICES

Appendix 1 – Global Market model for the long-only strategy

SUMMARY OUTPUT [GLOBAL MARKET MODEL - LONG ONLY STRATEGY]

Regression Statistics	
Multiple R	0.732771299
R Square	0.536953776
Adjusted R Square	0.535159023
Standard Error	0.025641298
Observations	260

ANOVA					
	df	SS	MS	F	Significance F
Regression	1	0.196703578	0.196703578	299.1797949	4.95282E-45
Residual	258	0.169628845	0.000657476		
Total	259	0.366332424			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	0.000664046	0.001601531	0.414631708	0.678756077	-0.002489692	0.003817783	-0.002489692	0.003817783
Mkt-RF	0.64754254	0.037437098	17.29681459	4.95282E-45	0.573821355	0.721263725	0.573821355	0.721263725

Appendix 2 – Carhart 4-factor model for the long-only strategy

SUMMARY OUTPUT [CARHAR GLOBAL 4FACTOR MODEL - LONG ONLY STRATEGY]

Regression Statistics	
Multiple R	0.946839559
R Square	0.896505151
Adjusted R Square	0.894881702
Standard Error	0.01219346
Observations	260

ANOVA					
	df	SS	MS	F	Significance F
Regression	4	0.328418905	0.082104726	552.2226852	2.9106E-124
Residual	255	0.037913519	0.00014868		
Total	259	0.366332424			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	0.001311014	0.000774111	1.693574599	0.091567252	-0.00021345	0.002835478	-0.00021345	0.002835478
Mkt-RF	0.746597531	0.018462468	40.43866417	6.3985E-113	0.710239198	0.782955864	0.710239198	0.782955864
SMB	-0.507393186	0.031010527	-16.36196589	1.25069E-41	-0.568462545	-0.446323828	-0.568462545	-0.446323828
HML	-0.180208635	0.024458534	-7.367924464	2.40634E-12	-0.228375085	-0.132042184	-0.228375085	-0.132042184
WML	-0.064665829	0.017515116	-3.69200111	0.000272123	-0.099158533	-0.030173125	-0.099158533	-0.030173125

Appendix 3 – Global Market model for the long-short strategy

SUMMARY OUTPUT [GLOBAL MARKET MODEL - LONG SHORT STRATEGY]

Regression Statistics	
Multiple R	0.45105622
R Square	0.203451713
Adjusted R Square	0.200364317
Standard Error	0.030450214
Observations	260

ANOVA					
	df	SS	MS	F	Significance F
Regression	1	0.061101187	0.061101187	65.89750165	1.95672E-14
Residual	258	0.239221608	0.000927216		
Total	259	0.300322796			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	0.005087563	0.001901892	2.675001643	0.007950608	0.001342356	0.008832771	0.001342356	0.008832771
Mkt-RF	0.360900097	0.044458266	8.117727616	1.95672E-14	0.273352817	0.448447377	0.273352817	0.448447377

Appendix 4 – Carhart Global 4-Factor model for the long-short strategy

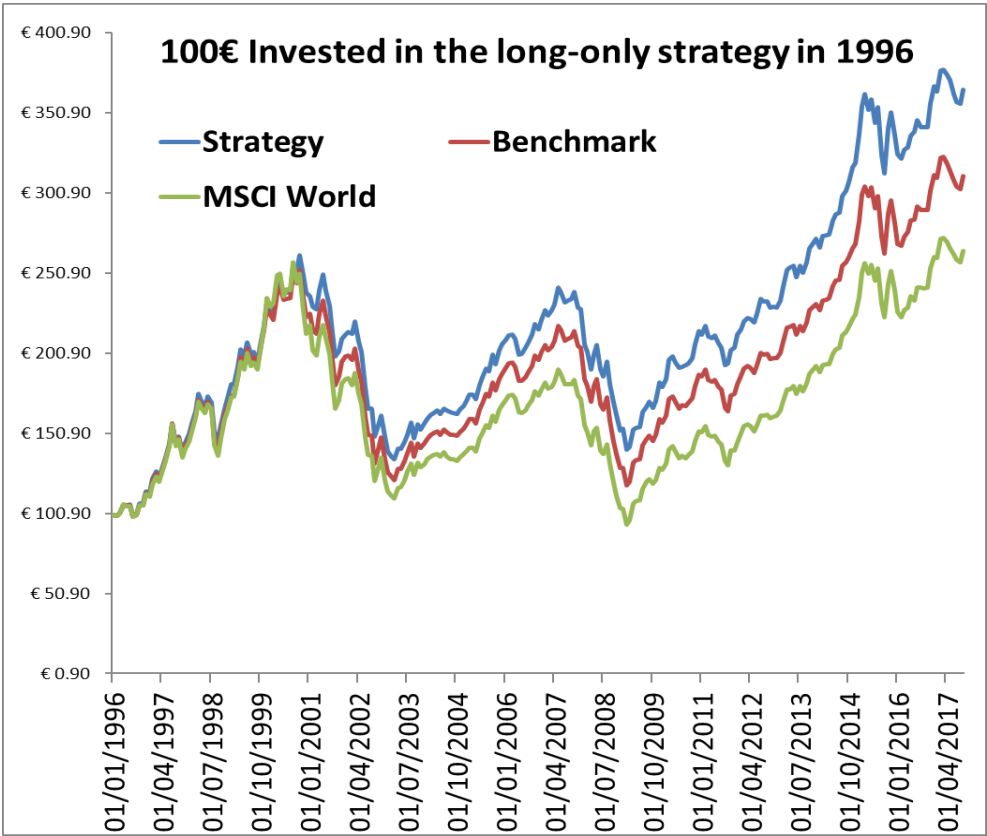
SUMMARY OUTPUT [CARHAR GLOBAL 4FACTOR MODEL - LONG SHORT STRATEGY]

Regression Statistics	
Multiple R	0.699294759
R Square	0.48901316
Adjusted R Square	0.48099768
Standard Error	0.024531772
Observations	260

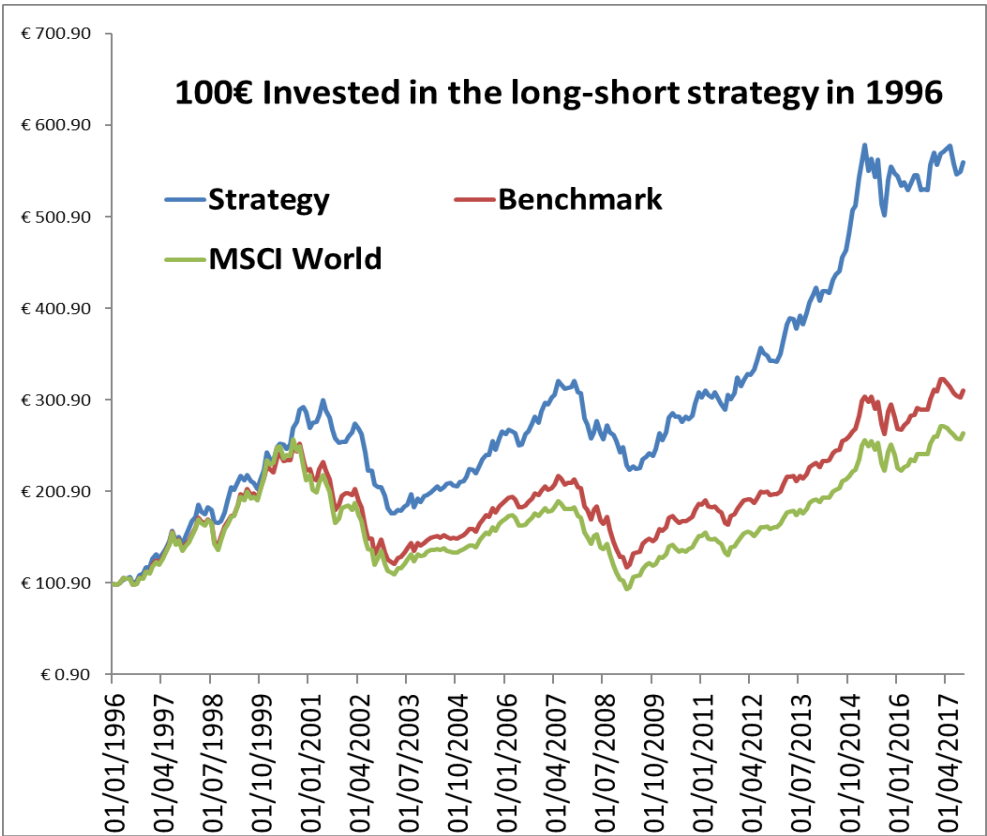
ANOVA					
	df	SS	MS	F	Significance F
Regression	4	0.146861799	0.03671545	61.00859447	4.20707E-36
Residual	255	0.153460996	0.000601808		
Total	259	0.300322796			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	0.004004579	0.001557417	2.57129479	0.010699598	0.000937541	0.007071617	0.000937541	0.007071617
Mkt-RF	0.472029336	0.03714426	12.70800222	5.43488E-29	0.398880753	0.545177919	0.398880753	0.545177919
SMB	-0.643385487	0.062389443	-10.31240955	4.55589E-21	-0.766249676	-0.520521297	-0.766249676	-0.520521297
HML	-0.021644999	0.049207623	-0.439870839	0.660403234	-0.118550092	0.075260094	-0.118550092	0.075260094
WML	0.130535053	0.035238303	3.704351299	0.00025985	0.061139891	0.199930216	0.061139891	0.199930216

Appendix 5 – Cumulative returns for the long-only strategy



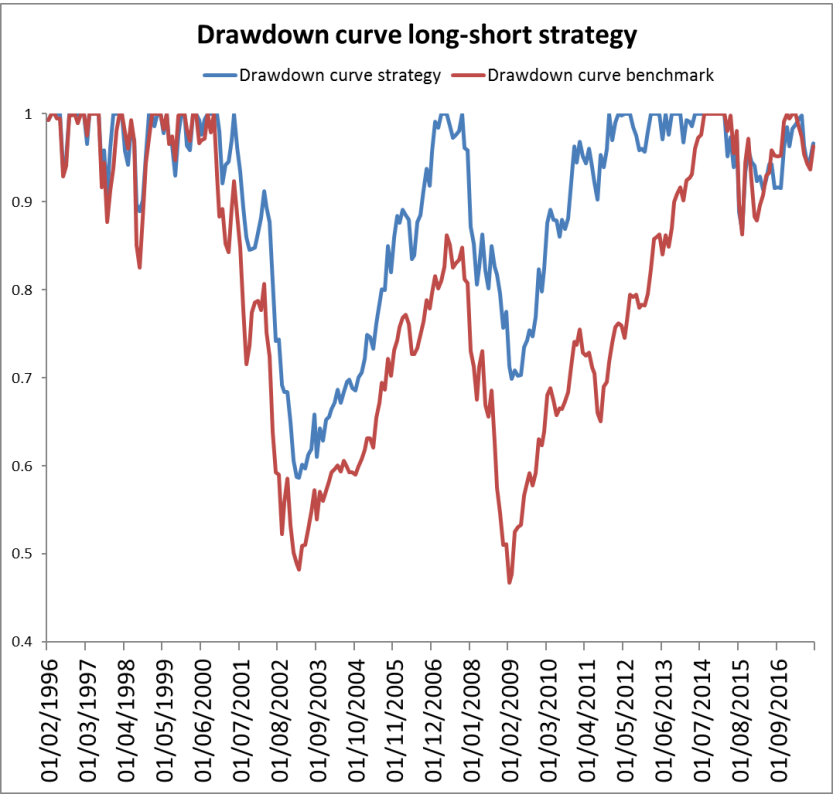
Appendix 6 – Cumulative returns for the long-short strategy



Appendix 7 – Draw-down curve for the long-only strategy



Appendix 8 – Draw-down curve for the long-short strategy



Appendix 9 – Annual relative performance for the long-only strategy

<i>Year</i>	<i>Annual returns of the long-only strategy in €</i>	<i>Annual returns of the benchmark in €</i>	<i>Out/Underperformance</i>
<u>1996</u>	13.8%	12.4%	1.4%
<u>1997</u>	32.3%	31.0%	1.3%
<u>1998</u>	14.8%	13.6%	1.2%
<u>1999</u>	34.7%	36.8%	-2.1%
<u>2000</u>	2.4%	-2.4%	4.8%
<u>2001</u>	-10.9%	-11.0%	0.1%
<u>2002</u>	-30.1%	-32.3%	2.3%
<u>2003</u>	5.7%	7.5%	-1.8%
<u>2004</u>	6.8%	6.3%	0.5%
<u>2005</u>	23.0%	22.3%	0.7%
<u>2006</u>	7.5%	7.2%	0.3%
<u>2007</u>	2.8%	1.4%	1.4%
<u>2008</u>	-33.1%	-36.8%	3.7%
<u>2009</u>	19.8%	23.6%	-3.8%
<u>2010</u>	17.4%	17.4%	-0.1%
<u>2011</u>	-1.0%	-3.1%	2.1%
<u>2012</u>	8.1%	9.0%	-0.9%
<u>2013</u>	18.7%	17.2%	1.6%
<u>2014</u>	17.3%	16.0%	1.3%
<u>2015</u>	5.4%	4.9%	0.5%
<u>2016</u>	9.1%	10.7%	-1.6%
<u>2017</u>	-0.6%	-0.2%	-0.4%

Appendix 10 – Annual relative performance for the long-short strategy

<i>Year</i>	<i>Annual returns of the long-short strategy in €</i>	<i>Annual returns of the benchmark in €</i>	<i>Out/Underperformance</i>
<u>1996</u>	18.0%	12.4%	5.7%
<u>1997</u>	36.2%	31.0%	5.2%
<u>1998</u>	18.2%	13.6%	4.7%
<u>1999</u>	28.4%	36.8%	-8.5%
<u>2000</u>	17.8%	-2.4%	20.2%
<u>2001</u>	-11.1%	-11.0%	-0.2%
<u>2002</u>	-23.3%	-32.3%	9.0%
<u>2003</u>	0.3%	7.5%	-7.2%
<u>2004</u>	8.3%	6.3%	2.0%
<u>2005</u>	25.2%	22.3%	2.9%
<u>2006</u>	8.2%	7.2%	1.0%
<u>2007</u>	7.0%	1.4%	5.6%
<u>2008</u>	-21.0%	-36.8%	15.8%
<u>2009</u>	8.8%	23.6%	-14.8%
<u>2010</u>	17.0%	17.4%	-0.5%
<u>2011</u>	5.1%	-3.1%	8.1%
<u>2012</u>	5.3%	9.0%	-3.7%
<u>2013</u>	23.6%	17.2%	6.4%
<u>2014</u>	21.2%	16.0%	5.2%
<u>2015</u>	6.9%	4.9%	2.0%
<u>2016</u>	4.1%	10.7%	-6.5%
<u>2017</u>	-1.8%	-0.2%	-1.6%